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ON A SPECIMEN OF *DIPLOXYLON* FROM
THE COAL-FORMATION OF NOVA SCOTIA.

NOTE on a SPECIMEN of DIPLOXYLON from the COAL-FORMATION of
NOVA SCOTIA. By J. W. DAWSON, LL.D., F.R.S., F.G.S.

IN a recent visit to the South Joggins, with the view of further studying the fossils of that district, and more especially of searching for reptilian remains in any erect stumps of *Sigillaria* that might have been exposed by the action of the waves, I was zealously aided by my friend Mr. Albert J. Hill, Manager of the Cumberland Mine*, who, after my departure, determined to take down some erect trees occurring in beds lower in the section than those containing the reptilian remains. In pursuing this investigation he discovered an erect tree twelve feet in height, having the whole of its woody axis perfectly preserved, *in situ*, and showing structure. As this appears to me to be important with reference to questions now in discussion, I beg to present to the Society Mr. Hill's description of the specimen and some remarks on its structure and affinities.

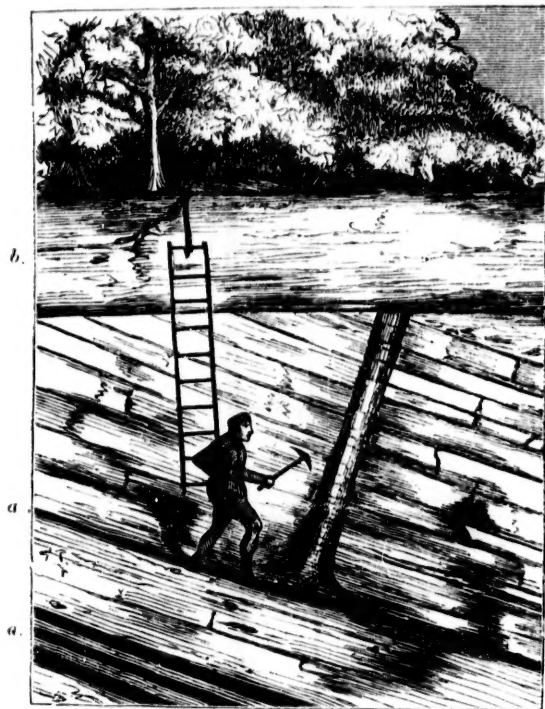
Mr. Hill thus describes the mode of occurrence of the specimen:—

"The tree in question stood partially exposed near the top of a perpendicular cliff, one hundred and twelve feet above the beach (fig. 1). The means of reaching and successfully extracting it from the massive sandstone stratum in which it was still half imbedded, was a problem of no easy solution. The difficulty, however, was overcome by an adventurous workman, who undertook, by means of a ladder attached by a rope to a small tree upon the surface, to descend to a sloping ledge formed by the jutting-out of a coal-seam and superincumbent débris, and to form there a 'standage' from which subsequent operations could be carried on. Having successfully established himself in his eyry, the tree, which, from exposure to the weather and the action of the frost, readily divided itself into sections, was sent up piece by piece in safety to the surface.

"On removing the clay which covered the upper extremity of the stump, I was struck with the unusual appearance of a well-preserved stem or axis in the sandstone cast, and which exhibited structure in a remarkably distinct manner, though here from exposure it had become somewhat friable. Further down, however, it was perfectly calcified and showed its structure distinctly, except in the centre, which was occupied with a core of perfectly cylindrical form and consisting of grey sandstone. The outer surface of the axis is longitudinally striate, without joints, and occupies a position near the side of the cast, from which it is separated throughout by rather more than its own diameter, or about three inches.

* We were so fortunate as to find an erect *Sigillaria* containing the remains of no less than *thirteen* small batrachians, belonging to six species, two of them new. So soon as these can be worked out from the matrix, I hope to bring them under the notice of this Society.

Fig. 1.—*Surface of the Cliff, showing the position of the Tree.*
(From a sketch by Mr. Albert J. Hill.)



a, a. Coal-seams. *b.* Superficial Drift.

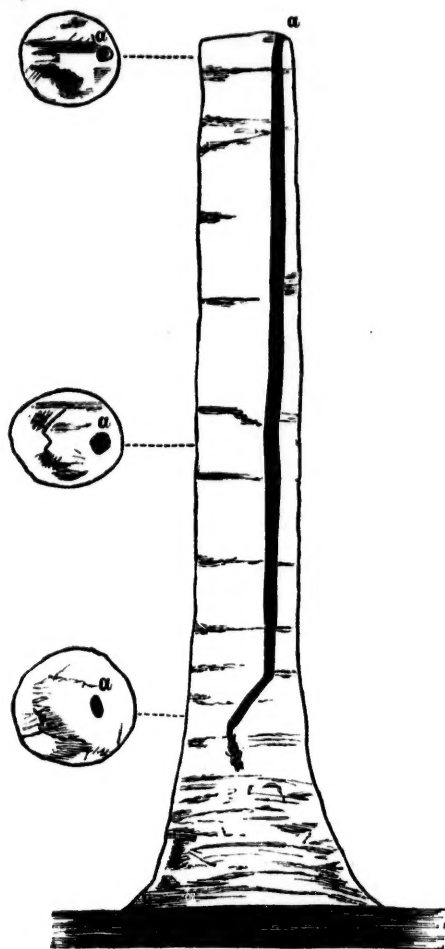
"The stump was found to originate in a six-inch coaly seam, thirty-five feet five inches below that worked in the Cumberland Mine in coal-group 29*a* of Dr. Dawson's section, or division 4, section xi. of Sir W. E. Logan's section*, and separated by an underlay of 3 feet 4 inches from the underlying seam of coarse coal in group 30. The downward termination of the tree exhibited spreading roots, which were, however, in a friable condition and not well preserved, but exhibited on the surface, inside the coaly bark, a fine transverse striation, scarcely visible to the naked eye. The surface-markings of the trunk are also indistinct; but it shows a coarse longitudinal striation and indications of broad flat ribs. The accompanying drawings (figs. 1 and 2) will illustrate the mode of occurrence of the tree in the cliff, and also the principal dimensions of the trunk and axis, with the position of the latter in the east."

The axis of this remarkable stem is about six centimetres in its

* *Acadian Geology*, 2nd edition, p. 171.

greatest diameter, and consists of a central pith cylinder and two concentric coats of scalariform tissue (fig. 3). The pith cylinder is replaced by sandstone, and is about one centimetre in diameter. The inner

Fig. 2.—*Longitudinal and Transverse Sections of the Trunk, showing the position of the Axis.* (Scale $2\frac{1}{2}$ feet to 1 inch. Drawn by Mr. Hill.)

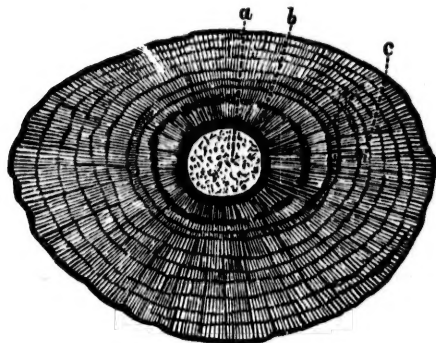


a, a, a. Internal axis.

cylinder of scalariform tissue is perfectly continuous, not radiated, and about one millimetre in thickness. Its vessels are somewhat crushed, but have been of large diameter. Its outer surface, which

readily separates from that of the outer cylinder, is striated longitudinally. The outer cylinder, which constitutes by much the largest part of the whole, is also composed of scalariform tissue; but this is radially arranged, with the individual cells quadrangular in cross section. The cross bars are similar on all the sides and usually simple and straight, but sometimes branching or slightly reticulated. The wall intervening between the bars has extremely delicate longitudinal waving lines of ligneous lining, in the manner first described by Williamson*, as occurring in the scalariform tissue of certain *Lepidodendra* (fig. 4). A few small radiating spaces, par-

Fig. 3.—*Axis of Diploxylon, as seen on weathered surface.* (Natural size.)



- a. Medullary cylinder, filled with sandstone.
- b. Medullary sheath of scalariform tissue.
- c. Exogenous cylinder of scalariform tissue, radially arranged and with concentric lines.

Fig. 4.—*Portion of Scalariform Tissue.* (Magnified.)



tially occupied with pyrites, obscurely represent the medullary rays, which must have been very feebly developed. The radiating bundles passing to the leaves run nearly horizontally; but their structure is very imperfectly preserved. The stem being old and probably long deprived of its leaves, they may have been partially disorganized before it was fossilized. The outer surface of the axis is striated longitudinally, and in some places marked with impressions of tortuous fibres, apparently those of the inner bark. In the cross section, where weathered, it shows concentric rings; but under the microscope these appear rather as bands of compressed tissue than as proper lines of growth. They are about twenty in number. Though apparently of very lax tissue, the wood of the outer cylinder may, in consequence of the strength of the vertical rods and transverse bars of

* Monthly Microscopical Journal, August 1869.

ligneous lining, have been of considerable firmness, which would, indeed, seem to be implied in the manner of its preservation within the hollow bark.

No trace remains of the thick inner bark, which is represented by sandstone; and, as usual in these trees, the outer bark consists of structureless coal. The outer surface of the sandstone cast shows longitudinal striation; but the ribs, if present, are very indistinct; and only a few somewhat remote and indistinct depressions remain as indications of the leaf-scars. The roots, as stated by Mr. Hill, show a delicate transverse wrinkling, which may be an effect of pressure. In one small portion only could I recognize on them the remains of the stigmarioid areoles.

When treated with an acid, the calcareous matter is removed and the wood remains as a crumbling dark brown mass, which shows the structure very perfectly when diffused in water or Canada balsam. When this brown substance is ignited it burns with scarcely any flame, and leaves a reddish ash, in which the bars of the scalariform tissue are still quite apparent.

In some parts of the axis the medullary cylinder becomes reduced in size, and the inner scalariform cylinder proportionally thickened. Towards the top of the axis there is an indication of bifurcation, which may, however, be a deceptive appearance resulting from mechanical splitting due to decay.

The structures above described are obviously those of *Diploxyton* of Corda; and the tree may be regarded as a *Sigillaria* of this type, the only well-characterized one yet found in the Nova-Scotia coal-field. In comparison with the axes of *Sigillariae* which I have described in former papers presented to this Society, it agrees in the general arrangement of the tissues, but differs considerably in their character. The pith cylinder is smaller and not Sternbergian. The scalariform tissue of the inner woody cylinder and medullary sheath is much coarser. The outer cylinder, instead of pseudo-scalariform and porous tissue, like that of Cycads, has coarse scalariform tissue. In these respects the trunk resembles those recently described by Williamson*, and is also like specimens from Arran shown to me some years ago by Mr. Carruthers. From the examples given by the former, I cannot doubt that such trees come within the limits of the genus *Sigillaria*, as determined by the markings of the bark; and that they belong to that low type of these trees in which the woody matter, while arranged in an exogenous manner, is wholly scalariform, and with the medullary rays little developed. As Williamson has shown, these trees approach closely to *Lepidodendra* in their structure. On the other hand, the *Sigillariae* of the type of *S. elegans* of Brongniart, and of *S. spinulosa* of Renault and Grand'Eury, have a somewhat higher organization, and point to the still more elevated type described by me in 1870. There would thus appear, as I pointed out in my paper on the structures of coal in 1859, and in that on the conditions of accumulation of coal in 1865,

* Transactions of the Royal Society.

and still more fully in that on *Sigillaria* and its allies in 1870*, several distinct types of Sigillarioid trees; though whether we can, as suggested in those papers, separate those with the *Clathraria* and *Favularia* styles of markings from the other *Sigillariae*, is still doubtful. The French authors above cited regard their *S. elegans* and *S. spinulosa*, which are of the *Favularia* type, as true *Sigillariae*, and hold that their woody cylinder, with its fibres in radial series and with medullary rays and radiating bundles proceeding from the inner cylinder, allies these trees with the gymnospermous exogens. Williamson regards his *Sigillariae* of the *Diploxyylon* type of structure as probably cryptogamous and allied to *Lepidodendron*, though maintaining that the structure of these stems is truly exogenous. There can scarcely be any doubt that the higher type of *Sigillaria*, which I described in 1870, and which, I think, represents the ordinary coarsely-ribbed species of the type of my *S. Brownii*, are allied to gymnosperms. Prof. Newberry and the writer have adduced strong circumstantial evidence to show that *Sigillariae* produced the fruits known as *Trigonocarpa*, found so constantly with their remains. Goldenberg, on the other hand, has figured a sort of strobile as attached to *Sigillaria*. Williamson has figured fruit-scars, which he regards as attachments of cones. I have figured† well-preserved fruit-scars of two species which cannot have borne strobiles, but may very probably have borne *Trigonocarpa* or racemes of such fruits. These facts, I think, taken along with those of structure, tend to show that there may be included in the genus *Sigillaria*, as originally founded on the markings of the surface, species widely differing in organization, and of both gymnospermous and acrogenous rank. This conclusion is further confirmed by the fact, which I have long ago amply demonstrated in my papers on the structures and mode of accumulation of coal, that in the great coal-beds tissues of gymnospermous character, but distinct from those of Conifers, exist to an enormous amount, while no other trees are found in connexion with these beds to which such tissues can be referred except the *Sigillariae*.

Should this view be finally established, these trees will present an interesting link of connexion between the gymnosperms and the higher cryptogams. They connect the *Lepidodendra* with the Cycads and Conifers in the gradations of exogenous structure seen in their wood and bark, and also in the remarkable transitions which they exhibit between woody tissues of the discigerous type and those scalariform tissues which, though resembling scalariform vessels properly so called, yet in these plants are evidently arranged in the manner of woody fibres, and take the place of these in the construction of the stem.

The tendency of investigation of late has been to convey the impression that the Sigillarioid and Lepidodendroid trees of the coal-formation were of one somewhat uniform and monotonous type. On the other hand, the great number of species of these trees indicated

* Quart. Journ. Geol. Soc. vol. xxvii. (1871) p. 147.

† Quart. Journ. Geol. Soc. vol. xxii. Report on Fossil Plants of the Lower Carboniferous: 1873.

by external markings, the number of kinds of gymnospermous fruits and cryptogamous strobiles associated with them, and the great range of organization presented by their stems, indicate a considerable variety of generic and specific types, probably bridging over, by means of the class of Gymnosperms, the great gap at present existing between the Angiospermous and Acrogenous trees, and giving an amount of diversity to the forests of the coal-period of which we have as yet little conception. A further illustration of this is presented by the remarkable species of *Cordaites* recently described by M. Grand'Eury, and which furnish another varied series of Gymnospermous type.

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